Space Weather Technical Forecast

Issued on Tuesday, 31 January 2023 at 01:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storms on 31 January with risk declining through the period. Slight chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low throughout the last 24 hours, with only low-level C-class flare activity. There are five sunspots on the visible disc, with no significantly complex or active regions. Four of the regions are bipolar, including a new region emerging across the eastern limb, along with one unipolar region in the northwest. A number of southwest directed CMEs have been observed through the last few days, but none of these are forecast to affect the Earth. Therefore no Earth directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 by DSCOVR, followed a declining trend, as the Earth exited the high speed stream from coronal hole 71. Speeds then sharply increased from around 30/2000UTC due to the connection with a further high speed stream, likely from coronal hole 72, reaching peak speeds of 450-500km/s by the end of the period. Density started with a declining trend, but then demonstrated a steady increase due to a CIR (co-rotating interaction region) ahead of the new high speed stream. Density peaked at 17ppcc at around 30/1730UTC, before declining as the high speed stream became established. Magnetic field strength was weak for much of the period, including through the CIR and initial onset of the high speed stream, but has recently followed a second increase, reaching close to 9nT by 30/2359UTC. The north-south component was close to neutral through much of 30 January, but then became weakly positive from around 30/1200|UTC, reaching +6nT by 30/1733UTC, then reached a sharp negative peak of -6nT at 30/2035UTC, but appears to have returned to mainly neutral levels. Phi angle was negative (towards the Sun) until 30/1552UTC, The orientation then became strongly positive, before gradually rotating back into the negative sector. Geomagnetic activity was mainly Quiet, with one Unsettled interval at the end of the period.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 has been at Background levels throughout.

High energy electron flux (greater than 2 MeV) has oscillated mainly between moderate and background level, just exceeding the high threshold briefly on four occasions between 30/1855UTC and 30/2230UTC, although none of these increase were sustained and the flux has now fallen to moderate to background levels. Associated 24 hour electron fluence has been below the Active threshold throughout, reaching 2.56e7 integrated pfu at 30/2359UTC on a steady trend.

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Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be predominantly Low, with no significantly active regions on, or due to rotate onto, the visible disc, with a slight chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast in the next four days. A current high speed stream is expected to give speeds of 400-500km/s through much of the period, with a declining trend towards the end of the period. Geomagnetic activity is expected to start Unsettled, with a risk of Active or G1/Minor Storm periods, this risk declining as the period progresses.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES16 is expected to remain at background levels. Electron flux is forecast to start exceeding the high (1e3pfu) level more frequently on diurnal highs during the next four days. Electron fluence values are forecast to rise towards the Active (1e8 integrated pfu) threshold in response to the increasing flux values.

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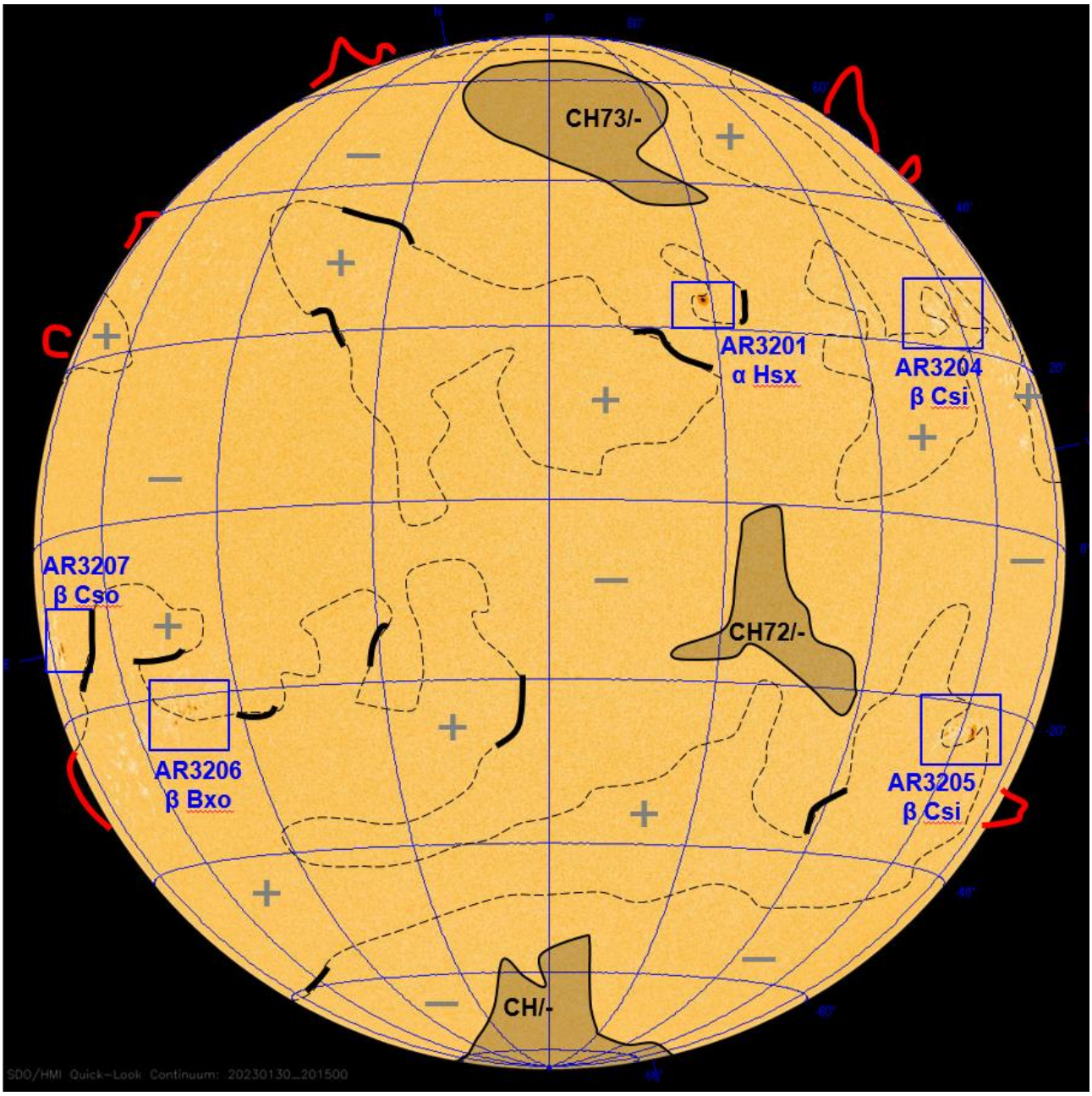
Figure 1. Solar Analysis Valid 30/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are expected in the next four days.

The Earth is currently coming under the influence of a coronal hole high speed stream, most likely the equatorial 72, but with a possible influence from coronal hole 73 in the northern hemisphere. Given the apparent early onset of the coronal hole, based on latitude and peak wind speeds, it is likely that the full area of the feature are massed by magnetic looping on satellite imagery. Both holes were evident on the last rotation, but with relatively muted geomagnetic activity. As the Earth moves towards the march equinox, the negative coronal holes tend to connect more strongly with the Earth, with a risk of geomagnetic storming. The onset of the current high speed was accompanied by a discernible CIR, although given a muted interplanetary magnetic field and slightly elevated solar wind speeds, this did not generate significant geomagnetic activity. Speeds appear to be averaging between 400-500km/s from this high speed stream, and based on STEREO A data, these speeds are likely to continue through into 01 February and consequently later into the forecast period.

Geomagnetic activity is forecast to be mainly Quiet to Unsettled through the forecast period, with a chance of Active or G1/Minor Storms on 31 January, with any activity declining through the period.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	20	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: 24-hour solar wind data

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Radio Blackouts - X-Ray Flares:

There are five sunspot regions on the visible disc, with all these showing limited growth and complexity. Farsided helioseismology suggests that a number of large plage areas are due to rotate across the eastern limb through the next five days. This agrees with the forecast of a number of returning regions and visible flux on STEREO A EUVI imagery. However none of these regions close to the eastern limb have produced significant activity over the last 48 hours, which limits their impact on the current forecast.

Solar activity is forecast to be mainly Low, with a slight chance of M-class flaring.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux as observed by GOES16 is currently expected to persist at background levels. None of the sunspots in or due to rotate into the western hemisphere carry a significant proton storm risk.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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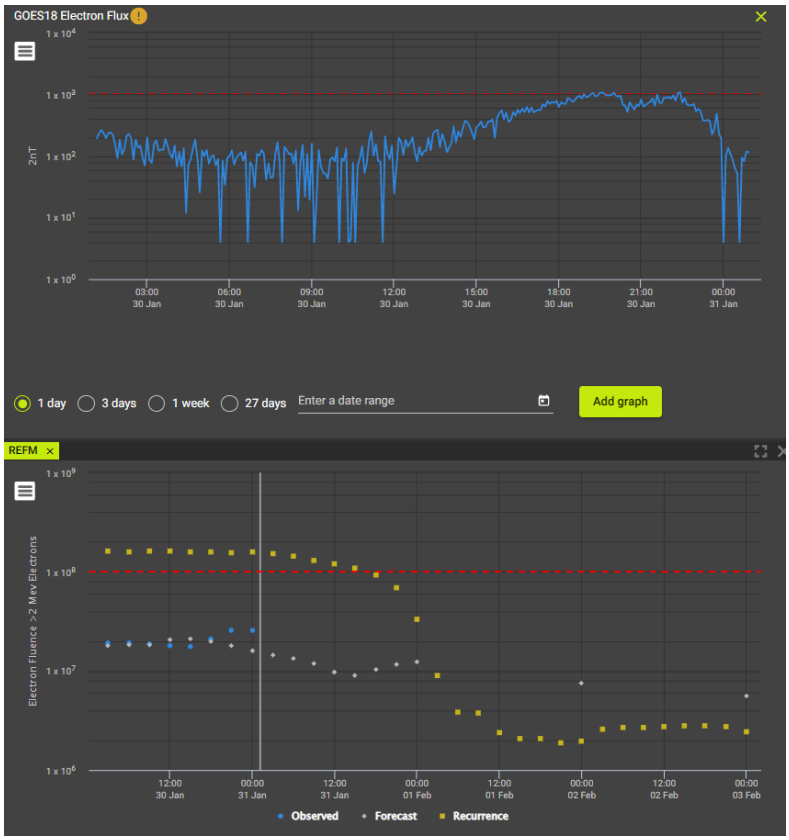
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is expected to oscillate between moderate and high levels through the next four days, due to the increased input from the current coronal hole high speed stream. More persistent periods of high electron flux are possible towards the end of the period, in the absence of any significant geomagnetic activity.

24 hour electron fluence is likely to follow an upward trend through the next four days, although the rate of any rise is uncertain, given the recent onset of the coronal hole high speed stream. There is a slight chance of reaching the threshold on 01 February, with a subsequent increasing risk through the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	10	20	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: GOES-16 electron flux and MOSWOC REFM model



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